(11)Publication number : 08-328357

(43)Date of publication of application : 13.12.1996

(51)Int.Cl. G03G 15/02

B41J 2/525

F16C 13/00

G03G 15/01

G03G 15/08

(21)Application number : 07-155510

(22)Date of filing : 31.05.1995

(71)Applicant : CANON INC

(72)Inventor : OKUBO MASAHARU

YUNAMOCHI TAKAYASU

HASHIMOTO NORIO

SHIMURA MASARU

(54) [Title of the Invention] IMAGE FORMING APPARATUS

(57) [Abstract]

[Object] An image forming apparatus is provided to reduce sticking of toner to an image holding member (photoreceptor drum) and to obtain an image of high quality.

[Construction] An image forming apparatus, in which an image holding member 3 is charged by using an electrostatic charging roller 4, and the development is performed simultaneously with recovering the toner left after transfer to a developer 5, characterized in that the electrostatic charging roller 4 includes a thin surface layer having a thickness of 100 to 1000 μm which is formed on a sponge layer having a thickness of 2 to 10 mm, and the hardness of the entire electrostatic charging roller is 35 to 55°, and in that the development is performed by using polymerized toner.

[Claims]

[Claim 1] An image forming apparatus, in which an image holding member is charged by using an electrostatic charging roller, and the development is performed simultaneously with recovering the toner left after transfer to a developer, characterized in that the electrostatic charging roller includes a thin surface layer having a thickness of 100 to 1000 μm which is formed on a sponge layer having a thickness of 2 to 10 mm, and the hardness of the entire electrostatic charging roller is 35 to 55°, and in that the development is performed by using polymerized toner.

[Claim 2] The image forming apparatus according to claim 1, wherein the electrostatic charging roller is applied with an AC voltage of 900Hz or more.

[Claim 3] The image forming apparatus according to claim 1 or 2, wherein the image holding member and the electrostatic charging roller are rotated at a speed different from each other.

[Claim 4] The image forming apparatus according to any one of claims 1 to 3, wherein the surface layer of the image holding member contains a lubricating agent of 2.5 to 50 wt%.

[Claim 5] The image forming apparatus according to claim 4, wherein the lubricating agent is fluororesin such as Teflon resin.

[Claim 6] An image forming apparatus, in which an image

holding member is charged by using an electrostatic charging roller, characterized in that the electrostatic charging roller includes a thin surface layer having a thickness of 100 to 1000 μm which is formed on a sponge layer having a thickness of 2 to 10 mm, and hardness of the entire electrostatic charging roller is 35 to 55°, and in that the development is performed by using color toner fabricated by a polymerization method.

[Claim 7] The image forming apparatus according to claim 6, wherein the image holding member is an intermediate transfer body of a color image forming apparatus.

[Claim 8] The image forming apparatus according to claim 6 or 7, wherein the electrostatic charging roller is applied with an AC voltage.

[Claim 9] The image forming apparatus according to any one of claims 6 to 8, wherein the surface layer of the image holding member contains a lubricating agent of 2.5 to 50 wt%.

[Claim 10] The image forming apparatus according to claim 9, wherein the lubricating agent is fluororesin such as Teflon resin.

[Detailed Description of the Invention]

[0001]

[Industrial Field of Application] The present invention relates to an image forming apparatus, and more particularly, to an electrostatic charging means for use in a laser beam printer and a copying machine.

[0002]

[Related Art] Conventionally, an apparatus shown below is used as an image forming apparatus.

[0003] Fig. 4 illustrates a general configuration of a laser beam printer (LBP) of the related art.

[0004] In the figure, reference numeral 1 denotes a scanner unit including an optical means and a scanning means for irradiating and scanning a laser light which is emitted in response to image information. In the figure, reference numeral 10 indicates a process cartridge built into a main image forming means, the process cartridge including a photoreceptor drum 3 serving as an image holding member, an electrostatic roller charger 4 made of semiconductive rubber, a developer 5 developing toner 6 on the photoreceptor drum 3, and a cleaner 8 removing waste toner from the photoreceptor drum 3. The photoreceptor drum 3 positioned in the process cartridge 10 is rotated in a direction indicated by an arrow, and the surface of the photoreceptor drum is uniformly electrostatically charged by the electrostatic charging roller 4. After that, the laser light emitted from the scanner unit 1 is irradiated onto the photoreceptor drum 3 via a mirror 2 to form an electrostatic latent image. The electrostatic latent image is transformed into a visible image as a toner image by supplying the toner from the developer 5. The toner image is transferred onto a transfer material, and then the remaining toner is recovered by the cleaner 8.

[0005] The cleaner 8 scrapes off the remaining toner from the photoreceptor drum 3 by using a cleaning blade.

[0006] As illustrated in the above example, the electrostatic charging means and the cleaning means are formed in a separate unit, and their functions are independent of each other.

[0007]

[Problems to be Solved by the Invention] A cleaningless LBP employing polymerized toner and a color machine employing polymerized toner have been recently used as an image forming apparatus.

[0008] The polymerized toner employed by the apparatuses has a substantially spherical shape due to its fabricating method, and friction-charged electrostatic potential is increased. Meanwhile, since the polymerized toner can be transformed into particulates without grinding, soft resin can be used, thereby fabricating the toner having high fixing ability. Accordingly, if the polymerized toner is employed, a fixing unit can be used at low temperature, which contributes to saving energy. In addition, if the color machine employs the polymerized toner, a good effect is obtained in that the toners are mixed with each other, and simultaneously, the toner having good coloration is manufactured.

[0009] In addition, since there is an advantage in that, due to the fabricating method, the grain size distribution of the toner is uniform and the toner of a clean spherical

shape is easily produced, the toner can be employed in various kinds of image forming apparatuses in the future.

[0010] However, if the toner of the substantially spherical shape fabricated by the polymerization method is employed, it cannot be appropriately cleaned by the existing cleaning means. With the toner of the substantially spherical shape, for two reasons, the spherical shape and the high electrostatic charge, the toner is leaked between the cleaning blade and the surface of the drum, thereby cleaning failure easily occurs.

[0011] In addition, since there are many cases where the polymerized toner uses soft resin, if the toner is applied with strong force, the toner is likely to be adhered to the surface of the image holding member, and the image is disturbed. In particular, if the electrostatic charging roller used in the existing apparatus employs a soft resilient member, permanent deformation resistance is deteriorated. Therefore, there are some cases in that the electrostatic charging roller is generally made of solid rubber. In a case where such an electrostatic charging roller is applied with a DC voltage, problems do not substantially arise. However, in a case where an AC voltage is applied, the electrostatic charging roller is vibrated in the upward and downward directions due to the influence of an electric field, thereby increasing a force sticking the toner to the image holding member. As a result, the toner is stuck to the image holding member, so

that white spots may be formed on a black image.

[0012] An object of the present invention is to solve the above problem of an image forming apparatus employing polymerized toner.

[0013]

[Means and Operation for solving the Problem] According to the present invention, in a cleaningless-type image forming apparatus employing polymerized toner or a color image forming apparatus also employing polymerized toner, in particular, among them, a color image forming apparatus employing an intermediate transfer body, the above problem is improved by using an electrostatic charging roller including a thin surface layer having a thickness of 100 to 1000 μm which is formed on a sponge layer having a thickness of 2 to 10 mm, in which the hardness of the entire electrostatic charging roller is 35 to 55°.

[0014] Next, the present invention will be described in detail with reference to the drawing.

[0015] Fig. 1 illustrates the general configuration of a major portion of a laser beam printer (LBP) according to an embodiment of the present invention.

[0016] In the figure, reference numeral 1 denotes a scanner unit including an optical means and a scanning means for irradiating and scanning a laser light which is emitted in response to image information. In the figure, reference numeral 10 indicates a process cartridge built into a main image forming means, the process cartridge

including a photoreceptor drum 3 serving as an image holding member, an electrostatic charging roller 4 made of semiconductive rubber, and a developer 5 developing toner 6 on the photoreceptor drum 3.

[0017] The photoreceptor drum 3 installed in the process cartridge 10 is an organic photoreceptor, and is rotated in a direction indicated by an arrow. After the surface of the photoreceptor drum 3 is uniformly electrostatically charged by the electrostatic charging roller 4, the laser light emitted from the scanner unit 1 is irradiated onto the photoreceptor drum 3 via a mirror 2 to form an electrostatic latent image. The electrostatic latent image is supplied with toner by the developer 5, and then is transformed into a visible image as a toner image.

[0018] Reference numeral 7 denotes a transfer roller which transfers the toner image formed on the photoreceptor drum 3 onto a transfer material 9 by supplying electric charges having polarity reverse to the toner to a rear side of the transfer material 9.

[0019] The transfer material 9 transferred with the toner image is carried to a fixing unit 12 by a carrier roller and a carrier guide 11. The fixing unit 12 applies heat and pressure to the toner image on the transfer material 9 to melt and fix the toner image onto the transfer material 9 and thus form a recorded image. After the image fixation, the transfer material 9 is discharged to a discharge tray 13 via each carrier passage selected by a flapper (not

shown).

[0020] Hardly any toner remains after transfer onto the photoreceptor drum, because the polymerized toner is employed, and a level of approximately 98% can be achieved. Since the polymerized toner of a substantially spherical shape is used as toner, a physical sticking force between the surface of the photoreceptor drum and the polymerized toner is relatively weak due to its shape. Since the polymerized toner is electrostatically stuck to the surface, if an electric field is applied to the photoreceptor toner to detach the toner electrostatically from the photoreceptor drum, the polymerized toner is relatively easily detached from the surface of the photoreceptor drum. The polymerized toner is nonmagnetic one-component toner.

[0021] Accordingly, a small amount of toner progresses to the electrostatic charging roller, and is uniformly distributed onto the electrostatic charging roller, and simultaneously electrostatic charging is performed. At that time, the velocity of the electrostatic charging roller is equal to that of the photoreceptor drum, but, in order to improve the uniform distribution effect, the circumferential velocity may be increased by 110 to 180%. In the case of increasing the circumferential velocity, the pressure between the electrostatic charging roller and the photoreceptor drum is increased, so that the toner is more strongly pressed against the photoreceptor drum.

[0022] In addition, in order to electrostatically charge

the photoreceptor drum more uniformly, it is necessary to increase a frequency of an AC voltage to be applied to the electrostatic charging roller according to the increased process speed. If the process speed exceeds about 100 mm/sec, it is necessary to increase the frequency over 1000 Hz in order to electrostatically charge the photoreceptor drum uniformly. If the frequency exceeds about 900 Hz, the amount of electric current is increased, so that the photoreceptor drum can be easily damaged.

[0023] Accordingly, in the cleaningless-type image forming apparatus employing the polymerized toner, the toner is twice as strongly pressed against the photoreceptor drum.

[0024] It is preferable that the surface layer of the photoreceptor drum contains a lubricant agent.

[0025] As a result, the frictional force is lowered. Even though the electrostatic charging roller and the photoreceptor drum have a difference in the circumferential velocity, the force pressing the toner against the photoreceptor drum is lowered. In addition, the sticking force of the toner to the surface of the photoreceptor drum is also lowered, and thus the sticking of the toner to the drum is decreased. It is preferable that the surface layer of the photoreceptor drum contains 2.5 to 50 wt% particulates of fluororesin such as Teflon resin as the lubricant agent.

[0026] The toner passing through the electrostatic charging roller is developed by the developer, and

simultaneously, is recovered by the developer. Since a vibration electric field is applied to a developing position, the toner on the surface of the photoreceptor drum is transferred from the surface of the drum and then is recovered in the container of the developer.

[0027] In the above description, although a jumping development method is employed as a development method, a contact development method using nonmagnetic one-component toner may be employed. This development method applies only CD voltage to a toner carrier. However, since the toner carrier of the developer comes into direct contact with the photoreceptor drum, the electric field caused by the toner carrier and the drum is strong in comparison with jumping phenomenon, so that the unnecessary toner of a non-printing area can be relatively easily recovered in the container of the developer.

[0028] Fig. 2 is a view illustrating the electrostatic charging roller used in the LBP of Fig. 1.

[0029] The electrostatic charging roller 4 includes a cored bar 20 of about 6 to 8φ, and a sponge layer 21 of EPDM, urethane rubber, epichlorohydrin rubber or the like formed on the cored bar, and the sponge layer has conductivity caused by distribution of carbon. The appropriate thickness value of the sponge layer 21 is 2 to 10 mm. If the sponge layer is thick, the resistance value is increased. If the sponge layer is thin, the hardness is not sufficiently lowered. The surface of the sponge layer

may be a skin layer or may be ground.

[0030] The sponge layer is covered by a resistance layer 22 made of conductive nylon resin or acrylic resin. A surface layer is formed on the resistance layer to have an appropriate thickness value of 100 to 1000 μm. If the resistance layer is thick, the hardness becomes high, and if the resistance layer is thin, a pressure resistance becomes low. In addition, a surface layer having a thickness of 5 to 30 μm is formed on the resistance layer.

[0031] The hardness of the whole electrostatic charging roller is preferably in the range of 35 to 55°, more preferably, 40 to 50°, according to a method of Asker C.

[0032] By using the electrostatic charging roller having the above configuration, it is possible to reduce the noise generated between the image holding member and the electrostatic charging roller and to significantly reduce a wear amount of the surface of the image holding member, even by applying an AC voltage. For example, in the LBP of Fig. 1, in a case where the circumferential velocity of 1000 Hz is applied at the circumferential velocity of 100 mm/sec, when the existing electrostatic charging roller made of solid rubber material (e.g., its hardness is 60°) was used, noise of 57 phon was recorded. However, when the electrostatic charging roller according to this embodiment was used, the noise was reduced by 50 phon, which is a practically useful level. In the electrostatic charging roller according to this embodiment, if the hardness is 55°,

the noise is 54 phon, and the noise is still high. In addition, if the hardness is low, the permanent deformation is increased, which is not practical. Although the permanent deformation occurs at the hardness of 35°, the deformation is inconspicuous outside of a halftone image, and if it is above 40°, the deformation is inconspicuous even in the halftone image.

[0033] In addition, the sticking of the polymerized toner to the photoreceptor drum which is the gist of the present invention could be significantly reduced.

[0034] Although the known polymerized toner can be applied to the image forming apparatus of the present invention, the polymerized toner used herein is fabricated to have a double-layered structure by a suspension method, in which the interior is made of wax, and the outer layer is made of relatively thin solid resin such as polyester. It is fabricated to have a particle size of 5 to 7 μm.

[0035] Although the description is for the LBP of a cartridge type, it may be applied to a copying machine of a cartridge type. In addition, it may be applied to an LBP or copying machine which is not a cartridge type.

[0036] Fig. 3 is an example of a color machine using the electrostatic charging roller according to the present invention.

[0037] In the figure, reference numeral 41 denotes a photoreceptor drum using an organic photoreceptor and uniformly electrostatically charged by an electrostatic

charging roller 42. After that, the image is exposed to a laser light 43, and colors of yellow (Y), magenta (M), cyan (C) and black (Bk) are sequentially developed by four developers 44, 45, 46 and 47 which are arranged in a row. The developed toner is transferred to an intermediate transfer drum 49. A transfer bias is applied to the intermediate transfer drum 49, and thus the toner image on the photoreceptor drum is transferred onto the intermediate transfer drum 49. The process is repeated 4 times, and then four toner images of Y, M, C and Bk colors are transferred onto the intermediate transfer drum 49. Finally, the toner image is transferred onto a transfer material which is guided to a transfer guide by a transfer roller 50, and then is fixed by a fixing unit 52. The toner left on the photoreceptor drum 41 is accommodated in a cleaner 48.

[0038] The toner used for the development is the polymerized toner to improve fixing ability and coloration. In this color machine, a little toner remaining after leaking from the cleaner exists, and thus it is possible to prevent the toner from being stuck to the drum by configuring the electrostatic charging roller 42 as in Fig. 2.

[0039] Next, the formation of the image by the image forming apparatus according to the present invention will be described in detail by way of an example.

[0040]

[Examples]

(Example 1) An OPC photoreceptor of 30φ is used as a photoreceptor drum, and a roller of 12φ shown in Fig. 2 is used as an electrostatic charging roller. A sponge layer of the electrostatic roller is made of urethane rubber or EPDM, and a surface layer (resistance layer) is made of nylon resin, and its thickness is 20 μm. In addition, the hardness of the electrostatic charging roller is 49°. As polymerized toner, most of the toner has a substantially spherical shape, and an average particle size is about 7 μm.

[0041] At the time of forming the image, AC of 500 Hz and about 2 kV is applied to the electrostatic charging roller, with a DC component of -700 V being superimposed. A DC component of -500 V and an AC component of 2000 Hz and 1600 V are applied to the developer. At that time, a jumping development method is used as the development method. The photoreceptor drum is rotated at the speed of about 50 mm/sec, and the electrostatic charging roller is rotated at the speed of 150% in the same direction as the photoreceptor drum.

[0042] With the above configuration, an LBP was manufactured by using a major process part as one cartridge. In the LBP, a cleaning failure did not occur, and the configuration of the cleaning container could be remarkably downsized, so that the cartridge could be manufactured in a compact size. In addition, it was possible to achieve high image quality and to prevent failure of electrostatic

charge or sticking of the toner to the drum by using the polymerized toner. Also, it was possible to obtain a good image up to 1000 sheets.

[0043]

(Example 2) Those in Example 1 are used as a photoreceptor drum and an electrostatic charging roller. As a cleaning roller, a sponge roller of 12φ is used.

[0044] As polymerized toner, most of toner has a substantially spherical shape, and an average particle size is about 6 μm.

[0045] At the time of forming the image, AC of 1000 Hz and about 2 kV is applied to the electrostatic charging roller, with a DC component of -700 V being superimposed. A DC component of -500 V and an AC component of 2000 Hz and 1600 V are applied to the developer. At that time, a jumping development method is used as the development method. The photoreceptor drum is rotated at the speed of about 100 mm/sec, and the electrostatic charging roller is rotated at equal speed in the same direction as the photoreceptor drum.

[0046] With the above configuration, an LBP was manufactured by using a major process part as one cartridge.

[0047] In the LBP, a cleaning failure did not occur, and the configuration of the cleaning container could be remarkably downsized, so that the cartridge could be manufactured in a compact size. In addition, it was possible to achieve high image quality and to prevent failure of electrostatic charge or sticking of the toner to

the drum by using the polymerized toner. Also, it was possible to obtain a good image up to 6000 sheets.

[0048] In this Example, a contribution is made to the size reduction and cost reduction of the LBP, without increasing a kind of high voltage.

[0049]

(Example 3) An OPC photoreceptor of 30φ is used as a photoreceptor drum, the OPC photoreceptor having a surface layer containing particulates (5 wt%) of Teflon resin. The same as Example 1 are used as an electrostatic roller, and a sponge roller of 12φ is used as a cleaning roller.

[0050] As polymerized toner, most of the toner has a substantially spherical shape, and an average particle size is about 6 μm.

[0051] At the time of forming the image, AC of 1000 Hz and about 2 kV is applied to the electrostatic charging roller, with a DC component of -700 V being superimposed. A DC component of -500 V and an AC component of 2000 Hz and 1600 V are applied to the developer. At that time, a jumping development method is used as the development method. The photoreceptor drum is rotated at the speed of about 100 mm/sec, and the electrostatic charging roller is rotated at the speed of 120% in the same direction as the photoreceptor drum.

[0052] With the above configuration, an LBP was manufactured by using a major process part as one cartridge. Since the surface layer of the OPC photoreceptor is mixed

with the particulates of Teflon resin, a frictional force is reduced. Even though the electrostatic charging roller and the photoreceptor drum have a difference in the circumferential velocity, the force pressing the toner against the photoreceptor drum is weakened. In addition, since the sticking force of the toner to the surface of the photoreceptor drum is weakened, the amount of the toner stuck to the drum is further decreased.

[0053] Accordingly, in the LBP, the configuration of the cleaning container could be remarkably reduced in size, so that the cartridge could be manufactured in a compact size. In addition, it was possible to achieve high image quality and to prevent failure of electrostatic charge or sticking of the toner to the drum by using the polymerized toner. Also, it was possible to obtain a good image up to 6000 sheets.

[0054]

[Effects of the Invention] As described above, it is possible to reduce the sticking of the toner to the image holding member by using the present invention. In addition, it is possible to reduce the noise caused by the electrostatic charge, and it is possible to promote energy saving of the image forming apparatus by using the polymerized toner.

[Brief Description of the Drawings]

[Fig. 1] Fig. 1 illustrates the general configuration of a laser beam printer according to an embodiment of the

present invention.

[Fig. 2] Fig. 2 illustrates the configuration of an electrostatic charging roller used in the laser beam printer of Fig. 1.

[Fig. 3] Fig. 3 illustrates the general configuration of a color laser beam printer according to another embodiment of the present invention

[Fig. 4] Fig. 4 illustrates the general configuration of a laser beam printer according to the related art.

[Reference Numerals]

3: photoreceptor drum (image holding member)

4: electrostatic charging roller

5: developer

6: toner

7: transfer roller